19 Dec 00

From: Captain James L. McClane, USN
To: Commander, Naval Surface Force, U.S. Atlantic Fleet

Subj: DAMAGE CONTROL IN USS COLE (DDG 67)

Ref: (a) COMNAVSURFLANT ltr 5830 Ser N02L/00343 of 8 Dec 00
(b) CINCLANTFLT ltr 5800 Ser N02L/276 of 7 Dec 00
(c) Captain Francis Russo, JAGC, USN, COMNAVSURFLANT FJA email of 11 Dec 00
(d) JAGMAN
(e) Captain James L. McClane, USN, ltr of 12 Dec 00

Encl: (1) USS COLE (DDG 67) Damage Control Event Timeline
(2) Captain James L. McClane, USN, ltr of 8 Dec 00
(3) List of COLE crewmembers interviewed
(4) List of documentation requested/provided
(5) Additional comments on COLE immediate lifesaving actions and emergency medical response
(6) Additional comments on COLE damage control and engineering systems
(7) Additional comments on COLE damage control training
(8) Findings of Fact and Opinions

1. In response to reference (a) and in accordance with references (b) through (d), I empanelled a team of experienced damage control and training personnel, enclosure (2), to assist in the inquiry into the damage control training and performance in USS COLE (DDG 67) following the 1118C, 12 October 2000 explosion. Additionally, Captain Konrad Hayashi, Medical Corps, USN, COMNAVSURFLANT Force Medical Officer and HMCM(SW) Raymond Bailey, COMNAVSURFLANT senior Hospital Corpsman, assisted with interviews and collection of information regarding COLE's onboard immediate lifesaving actions and emergency medical response.

2. Inquiry limitations: In view of the limited time available to complete the inquiry and the initial unavailability of written documentation and legal records, both group and individual interviews with selected COLE officers and crew, enclosure (3), were conducted. Access to pertinent logs, records, and other sources of information were requested by reference (e) and were used when available. Enclosure (4) lists the information received and reviewed for this inquiry. Based on interviews conducted and available documents, I consider this

report to be generally complete and an accurate account of COLE's damage control response from 1118C, 12 October 2000 until 1942C, 17 October 2000.

A damage control event timeline was developed from information gathered and is provided in enclosure (1).

3. Discussion. During discussions with COLE's officers and crew concerning damage control actions taken subsequent to the explosion, four general phases of action emerged which were used in constructing the post-explosion narrative that follows. These phases are generally linked to command decision points and put decisions and actions in context. The four phases are:

Phase One (121118C Oct 00 - 121140C Oct 00) - Actions taken to stabilize the ship and rescue personnel immediately after the explosion;

Phase Two (121141C Oct 00 - 150114C Oct 00) - Actions taken to and evacuate medical casualties while restoration from the initial explosion continued;

Phase Three (150115C Oct 00 - 160004C Oct 00) - Actions taken to recover from progressive flooding and loss of electrical power subsequent to initial damage control efforts; and

Phase Four (160005C Oct 00 - 171942C Oct 00) - Actions taken to prepare the ship for movement from Yemen. As these actions also involved extensive industrial and technical support, the beginning of this phase provides a logical point at which to end the narrative.

4. Narrative Account. (All times -3 Charlie)

a. **Prior to explosion**: COLE moored starboard side to at Aden, Yemen on 12 October 2000 at 0849. Her mooring configuration consisted of six mooring lines, head and stern lines passed to buoys with spring lines to the fueling dolphin. All lines were doubled and the anchor was dipped. Charted depth was 36 to 40 feet of water. No brow was across.

Following mooring, COLE had material condition Modified ZEBRA set on the main deck and below. Therefore, in addition to material condition YOKE being set, main hatches were closed and

dogged with hatch scuttles open (Damage Control Closure Log for 12 October 2000).

The engineering plant was in 15-minute standby with main engines secured. Three of the four main engines were aligned for immediate start (1A Main Engine was out of commission). Both main reduction gears were warmed and being jacked over. Lube oil service systems were running fore and aft with the "A" pumps on line. Both main fuel oil service systems were running with the "A" pumps on line. Supporting systems (lube oil, fuel oil and controllable pitch propellers hydraulics) were running. NRs 2 and 3 Ship's Service Gas Turbine Generators (SSGTG) were running in parallel. NR 1 SSGTG was secured in preparation for planned maintenance on the reduction gear. The steering system was in five-minute standby (aligned for underway operation with pumps secured).

NRs 2 and 5 firepumps were running with material condition YOKE (single continuous loop) set on the firemain. The Low Pressure (LP) and High Pressure (HP) Air Systems were aligned for normal operation with NR 2 Low Pressure Air Compressor (LPAC) and NR 2 High Pressure Air Compressor (HPAC) running in auto mode. The engineering plant control systems were aligned in normal mode with Central Control Station (1-268-0-C) in control of the engineering plant. CCS watch was posted as well as Inport Equipment Monitor (IEM) and Sounding and Security watches.

The ship commenced refueling all six F-76 fuel oil storage tank banks at 1031. At commencement of fueling, the ship had 37 percent (approximately 165,000 gallons) F-76 fuel onboard. Refueling was being managed by [redacted] Main Propulsion Assistant, from the Oil Test Laboratory (2-174-4-Q), assisted by two of the assigned oil kings, [redacted], and [redacted] At the time of the explosion, COLE had received 80,000 gallons and had filled one of the six tank banks. JP-5 (F-44) was at 90 percent capacity (18,000 gallons) and was not being received.

b. **Explosion**: The explosion occurred at 1118C opening a 40 by 60-foot hole in the port side between frames 174 and 220 and drove the main deck up into its overhead (the 01 level) at that point. Main Engine Room (MER) 1 (4-174-0-E) and the Dry Provisions Storeroom (2-220-4-A) began flooding immediately, having free communication with the sea. Flooding also occurred

in the Supply Support Center (3-220-2-Q), Freezer Storeroom (2-220-3-A) and Auxiliary Machinery Room (AMR) 2 (4-220-0-E). Minor flooding occurred in AMR 1 (4-126-0-E) through ruptured bleed air piping and damaged stuffing tubes. Additionally, there was intermittent flooding in MER 2 (4-254-0-E) through the main shaft seal between that space and AMR 2. The Crew and Chief Petty Officer's Galley (1-191-0-L), Command Master Chief Office (1-169-2-Q), Oil Test Laboratory, General Workshop (2-200-2-Q), Repair Locker 5 (1-206-3-A), and Chief Petty Officer Mess Room and Lounge (1-174-0-L) were structurally destroyed. There were no class "A" or class "B" fires. A number of small class "C" fires were quickly extinguished when the affected electrical equipment was isolated. The ship immediately settled to a 3.5 to 4 degree port list, trimmed by the head an undetermined amount.

Among the immediate effects, NR 2 SSGTG shut down. NR 3 SSGTG and switchboard remained in operation providing electrical power to the after portion of the ship. The electrical fault current detection system activated opening all bus tie breakers, deenergizing NRs 1 and 2 switchboards. The Interior Voice Communications System (IVCS) and the General Announcing System (1 MC) were disabled. The Wireless Internal Communications System (WICS) remained intact and became the ship's primary means of interior communication, supplemented by 25 MC and various X5J casualty communication circuits. The Data Multiplexing System (DMS) was unreliable, causing uncommanded cycling of motor-operated firemain valves and, coupled with explosion damage to firemain piping, contributed to a loss of firemain control and pressure.

Air conditioning, chilled, and potable water systems were disabled. Large quantities of fuel accumulated in MER 1 and AMR 2. Lighting was lost forward of Frame 220. The Propulsion Repair Locker (Repair 5) was damaged and unusable; however, damage control equipment in the locker was largely intact except for ventilation and portable desmoking equipment. (The intact equipment was subsequently redistributed to Repairs 2 and 3 and personnel assigned to Repair 5 went to the other repair lockers to assist in the damage control effort.) An estimated 20 Self-Contained Breathing Apparatuses (SCBA) stowed in the athwartships passageway near Repair 5 were destroyed. Loss of power forward rendered NR 1 Aqueous Film Forming Foam (AFFF) station inoperative. (AFFF was also lost shipwide as a result of loss of firemain pressure.)

c. **Actions of the crew.**

(1) **Phase One** (121118C Oct 00 - 121140C Oct 00)

CDR Lippold, Commanding Officer, was in his cabin (02-146-1-L) when the explosion occurred. He armed himself with a nine-millimeter pistol kept in his cabin, donned a flack jacket and proceeded to the Pilot House (04-130-0-C). On the way there he noted two personnel in the water, threw them a life ring and directed other crewmembers to recover them. Upon reaching the pilot house, he attempted to determine the threat to the ship and directed the weather decks secured in order to not expose personnel to possible follow-on attack. In the process, CDR Lippold was concerned by several black inflatable boats in the water (subsequently identified as life rafts blown from the ship by the explosion, inflated, and overturned, exposing their black bottoms). During the ensuing minutes, CDR Lippold received LCDR [redacted] damage report via WICS, contacted the port authorities on a hand-held Very High Frequency (VHF) radio and, in the absence of reliable external communications, had two Emergency Positioning Indicating Radio Beacons (EPIRB) put in the water.

[redacted], Executive Officer, was presiding over a meeting of the ship's Morale, Welfare and Recreation (MWR) Committee in the Ship's Crew Recreation and Training Room (2-350-2-L), located on the second deck, port side aft, when the explosion occurred. LCD[redacted] recalled sensing the ship moving toward the starboard side, with an attendant violent vertical movement simultaneous with hearing the explosion. He also sensed that the ship immediately began listing to port after the explosion occurred. After the shaking ceased, LCDR [redacted] led the MWR Committee, including HMCM(SW/AW/FMF) [redacted] (Command Master Chief) and LTJG [redacted] (Auxiliaries Officer and Repair 5 Locker Officer) toward the Mess Deck, proceeding forward along the port side of the ship until they were stopped by heavy smoke presumed to be from the explosion. They reversed direction and made their way past the Aft Battle Dressing Station (BDS) (2-410-1-L) to the starboard side main deck passageway. There they encountered personnel exiting the interior of the ship and some (six to 10 personnel) from the weather decks who were indicating, through pointing gestures that they had suffered ear damage. LCDR [redacted] was uncertain as to whether the ship remained under attack;

therefore, his immediate concern included ship security as well as damage control. Consequently, he directed GM2 [redacted] to man the after deck gun topside and directed other personnel in the passageway to man Repair 3 (2-410-2-A), check/set material condition ZEBRA, and investigate for damage in MER 2. Acting on that much direction, personnel reacted as trained and headed for their general quarters stations. LCDR [redacted] continued forward along the starboard side passageway. Noting several injured personnel along his path and observing SN [redacted] (corpsman striker) and others administering first aid to the injured in that area, he directed that the starboard side passageway area between CCS and the Medical Treatment Room (MTR) (1-220-3-L) become a staging/first aid/triage area. The MTR was unusable because of heavy smoke. LCDR [redacted] commented he was unable to determine if there were any fires at this point. LCDR [redacted] proceeded aft to CCS where he established communication with the Commanding Officer in the Pilot House via WICS (IVCS and the 1MC being inoperative) and assumed overall control of initial damage control efforts. LCDR [redacted] estimated the total time elapsed between the explosion and his arrival in CCS to be approximately 10 minutes.

LT [redacted] Chief Engineer, upon hearing the explosion and feeling the ship move, exited Officers' Country on the 02 level through the port side access en route to her CCS general quarters station. Determining that CCS was inaccessible from that side, she went to the Pilot House via a port side ladder to assess exterior damage. Leaving the pilot house, she donned an Emergency Escape Breathing Device (EEBD) and made her way through smoke to CCS via the starboard side passageway. There, she directed restorative actions for the engineering plant while the Executive Officer concentrated on damage control efforts. Concerned about the potential for fire in MER 2 due to large amounts of leaking fuel, LT [redacted] directed isolation of that space and securing of flammable and combustible liquid systems pending completion of damage investigation.

ENS [redacted] Damage Control Assistant (who had been aboard for about two months), was in the Filter Cleaning Shop (01-188-2-Q) on the 01 level port side at the time of the explosion. He made his way as far as the 01 level weather deck on the port side, crossed over to starboard, proceeded aft to the flight deck and entered the starboard interior passageway via the starboard side airlock. From there, he went forward to CCS (also Damage Control Central), his general quarters station. He estimated

arriving in CCS within 15 minutes of the explosion. By that time, the damage control organization was manning or had manned stations and ENS [redacted] immediately began receiving verbal, face-to-face damage reports from investigators. Additionally, he established communications with Repair 3 via Damage Control Wire-free Communications (DC WIFCOM).

Among many examples of personal heroism and individual initiative related to immediate lifesaving actions and emergency medical response, the following examples were specifically identified:

Lifesaving and emergency medical response began immediately following the explosion. DC1(SW) [redacted] HT1(SW) [redacted] HT2(SW) [redacted] DCFN [redacted] DCFN [redacted] and DCFN [redacted] were all involved in evacuating injured personnel from the Chief Petty Officers Mess, the area of the greatest concentration of injured personnel. In order to gain access to the space, Petty Officer [redacted] knocked down a false bulkhead then took charge of the initial effort to evacuate the wounded. Once all were rescued, this group assisted in the dewatering and shoring effort in AMR1 and MER 2.

OS2 [redacted] was also searching for survivors in the vicinity of the CPO Mess. Leading a group of four other rescuers through a small opening in the damaged port side, Petty Officer [redacted] noticed a critically injured crew member and immediately helped place him on a litter. Because of the extensive damage in the area and oil and debris on deck, he and his team were unable to maneuver the litter through the passageway. Recognizing the severity of the injury to his shipmate, Petty Officer [redacted] took the critically injured crewman in a fireman's carry and made his way through the damage to a place from which the injured Sailor could be evacuated topside.

BMC(SW/AW/DV) [redacted] was in the CPO Mess at the time of the explosion. Despite sustaining injuries to his leg and lungs, he made his way through the smoke and debris to obtain a SCBA, then searched for survivors in the vicinity of the damaged mess line, guiding one sailor to a battle dressing station. He then obtained emergency lighting from Repair 5 and returned to the CPO Mess to rescue several remaining personnel. Once the CPO Mess was evacuated, he reported to Repair 2 and assumed Damage Investigator duties and in the process safely evacuated several more personnel from spaces in the forward part of the ship.

In the first 90 minutes following the attack, HMCM(SW/AW/FMF) [redacted] rendered life saving medical treatment to more than twenty shipmates whose injuries ranged from lacerations to multiple fractures. He directed junior corpsmen and ship's company in life saving techniques and personally prepared many injured crew members for evacuation to medical treatment facilities ashore.

LTJG [redacted] went to Repair 2 immediately after the attack and directed DC efforts there until relieved by the locker leader. He then made his way to the Mess Deck to aid in rescue efforts there. With the assistance of others, he freed MS3(SW) [redacted] who had sustained multiple fractures to both legs and ankles, from the severely damaged Galley. Once she was evacuated safely, LTJG [redacted] returned to area of greatest damage and assisted in evacuating injured personnel from the CPO Mess and MER 1 area.

Additional information on immediate lifesaving actions and emergency medical response is provided in enclosure (5). Again, it should be noted that there are many other examples of personal heroism and individual initiative not presented in this report.

Within 15-20 minutes following the explosion, triage was well underway in the starboard passageway (near Frame 258) and at the aft BDS. Initial casualty evacuation was in progress, and personnel had manned their general quarters stations to the extent that COLE's damage control organization was functioning effectively. Key command personnel were aggressively coordinating the effort to evacuate casualties and save the ship.

Immediate damage effects described above were reported to CCS within approximately 20 minutes of the explosion. The smoke that had filled the ship's interior along the main deck level was dissipating rapidly (probably through the damaged hull) and there was no evidence of fire inside the ship. Further investigation determined that the Refrigeration Machinery Room (2-240-1-E), Pulper/Shredder room (2-240-6-Q), and Dry Provisions Storeroom were flooding into AMR 2 (source(s) of flooding could not be determined). AMR 1 was taking on manageable amounts of water through bleed air piping and leaking bulkhead stuffing tubes. Fuel from NR 1 SSGTG's Fuel Gravity

Feed Tanks (FGFT) (2-174-2-F) in fuel oil storage tanks banks NRs 1 and 2 (specific tank damaged has not been determined) and storage tanks was leaking from the ship through the hole in MER 1, constituting a significant fire hazard. In response to leaking fuel and lube oil, repair locker personnel emptied five gallons cans of AFFF concentrate into MER 1 through a natural ventilation shaft and into AMR 2 through the escape trunk. (Firemain and 60 Hz electrical power were not yet restored forward, resulting in AFFF Proportioning Stations NRs 1 and 2 being out of commission, necessitating the inefficient, but effective unmixed AFFF application).

Having taken immediate steps to treat and evacuate casualties while minimizing the potential for fire, the main damage control effort shifted focus to stopping flooding and removing water from the ship. Repair parties were rigging P-100 portable pumps to dewater AMR 1 and MER 2.

(2) **Phase Two** (121141C Oct 00 - 150114C Oct 00): Although electrical arcing and sparking had been observed in various spaces, no fires were discovered. Smoke was clearing rapidly. Initial investigations had been conducted and damage reported. The damage control organization was intact and the crew functioning in an organized effort to restore the ship's basic systems and capabilities. With that effort underway, CDR Lippold and LCDR [redacted] were comfortable they could focus Command level attention more closely on triage and casualty evacuation.

Subsequent to the explosion and his requesting assistance from the port authorities via the hand-held VHF radio, CDR Lippold was contacted by the U.S. Defense Attache (DATT), who had been in the port area and hurried via small boat to where COLE was moored. Leaving CDR Lippold with a cellular phone (by which CDR Lippold made his initial OPREP-3 report), the DATT commenced coordinating casualty evacuation through embassy channels. These arrangements were completed approximately one hour after the explosion had occurred.

COLE had previously developed a preplanned mass casualty response that included triage sites on the Mess Deck and at the Aft BDS. Circumstances were such that triage in the classic sense was not possible, but the preplanned triage procedures were nonetheless used to stabilize the injured and prepare them for evacuation off the ship. Because of extensive damage to the

Mess Deck and ongoing restoration efforts, the forward triage area was initially established in the starboard side passageway near the Engineering Department Office (1-258-3-Q). When the Commanding Officer permitted personnel to access the weather decks, the triage areas were moved to the flight deck, with HMCM(SW/AW/FMF) [redacted] in charge, and to the starboard quarterdeck area under the direction of HMC(SW) [redacted] From those locations, non-ambulatory patients were placed in Stokes and Search and Rescue (SAR) litters, lowered to the fueling dolphin by sliding them down a hurriedly rigged ladder and the ship's brow, and placed in boats for transport to medical facilities ashore.

Evacuation of the injured and transport of ship's company blood donors to the hospital were accomplished within two hours (Reportedly one hour and thirty-nine minutes.) Provision of sufficient water to cleanse wounds and to prevent dehydration in the 100-plus degree heat became a major concern. The emergency water supplies at the BDSs were depleted almost immediately. Bottled water procured during a French port visit for use in the repair lockers (in anticipation of training in the hot conditions of the Arabian Gulf) was also rapidly consumed. The crew made do by melting ice from the Wardroom Pantry icemaker supplemented by a large stock of Gatorade from Ship's Store. Water from off-ship was not received until late that night or early the next day.

By mid-afternoon 12 October, the crew had begun gaining ground on equipment restoration and flooding control. Firemain was restored to the aft starboard loop within 60 to 90 minutes after the explosion. Electricians were isolating components of the electrical distribution system, conducting detailed electrical damage investigation, and clearing grounds. Rigging casualty power from NR 3 switchboard to Communications Center (2-126-1-C) to power off-ship communications was reported by the crew to be a challenge. They had not recently practiced rigging casualty power and the electrical information on damage control diagrams was incorrect, slowing the process.

A crew muster was completed by 1500, and the flight deck transitioned from a triage area to a temporary messing and berthing area. Water remained a critical need and galley food supplies had been contaminated. The evening meal consisted mainly of snacks from ship's store stock. Security lighting was rigged topside and personnel rested in brief shifts.

At 1825, MER 2's starboard shaft bulkhead seal was reported to be leaking. The leak was brought under control by plugging the leak using oakum and damage control wedges; dewatering began using a P-100 pump. (An attempt to use the space eductor for dewatering failed due to misalignment of firemain valve (V-769) in Crew Living Space NR 4 (3-300-1-L)).

At 2213, NR 3 SSGTG blow-in doors opened and could not be closed due to lack of LP air. (Ship's force had previously installed Scott foam at the blow-in doors in preparation for FIFTH Fleet operations so they continued to run the generator.) SSGTG lube oil filters clogged and after shifting filters, clogged again. Replacement filter elements were not available therefore the installed filters eventually had to be removed to keep the engine supplied with lube oil, despite contamination of the lube oil.

Efforts to restore equipment operation, to restow damage control equipment, and to provide additional medical care to personnel continued through the evening and into the next day (13 October).

By noon on 13 October, casualty power had been rigged to the forward portion of the ship powering the 1MC General Announcing system and installed lighting forward of frame 174. Temporary lighting was rigged between frames 174 and 220 using friendship lights and extension cords. By early afternoon, air conditioning, potable water and CHT were operational in the after portion of the ship and air conditioning boundaries were established using damage control smoke curtains.

On 14 October, U.S. and Allied assistance began to arrive on scene and COLE's material condition continued to improve through the crew's efforts. The U.S. Marine Corps FAST team arrived in the early morning hours and assumed security duties. Mobile Diving and Salvage Unit TWO's master diver commenced diving operations. HMS MARLBOROUGH arrived and provided water and AFFF in the morning, and USS HAWES (FFG 53) and USS DONALD COOK (DDG 75) were on scene in the afternoon, providing food, clothing, medical supplies, additional damage control gear and relief crews.

COLE's power restoration effort continued and by 1931 the crew had rigged and energized casualty power from NR3

switchboard to Load Center 11 (2-53-1-C), enabling them to operate additional auxiliary equipment in the forward part of the ship, including vital auxiliaries in AMR 1.

At 2100, a rise in the water level in AMR 2 was noted and two additional PERI-jet eductors (for a total of five) were put in use to control flooding.

(3) **Phase Three** (121141C Oct 00 - 150114C Oct 00): At 0115 on 15 October the watch stationed in MER 2 reported the leak at the starboard shaft forward bulkhead seal adjacent to AMR 2 to be approximately five gallons per minute. By 0130, the leak was reported to have increased to approximately 15 gallons per minute. The MER 2 space eductor was placed in operation. At 0137, the Commanding Officer ordered Repairs 2 and 3 to be remanned in response to the increased flooding in AMR 2 and MER 2. By 0237, the flooding in AMR 2 reached six feet in the escape trunk. The source of the flooding remained undetermined.

At 0305, the ship lost electrical power. NR 3 SSGTG, which had been on line continuously since the explosion, shut down due to fuel starvation. With the generator's primary fuel supply unavailable after the explosion, ship's force had provided fuel from the JP-5 transfer system directly to the engine's gravity feed tank. Refilling was done based on estimated fuel consumption (The Fuel Control Console in the Oil Test Laboratory had been damaged in the explosion and there was no other normal means such as sounding tube or sight level indicator to positively monitor gravity feed tank.) With no HP air compressor available, leaks in the air system, and start air flasks depleted from earlier failed attempts to start NRs 2 and 3 SSGTG, ship's force had early in the day improvised an alternative method of refilling the flasks. Using desel-powered SCBA air compressors and fittings supplied by the Navy divers on board, ship's force was able to recharge the flasks through their gage lines. Repeated attempts to restart NR 3 SSGTG failed and as a result, COLE was to be without electrical power for nearly an entire day.

Without electrical power, COLE was also without firemain, auxiliaries and hotel services. The water level in AMR 2 continued to rise and portable dewatering equipment was removed in order to secure the space and prevent progressive flooding. The increased pressure on AMR 2's bulkhead began to dislodge shoring that had been constructed around MER 2's plugged

bulkhead shaft seal and the engine room water level also began to rise. Ship's force attempted to supply the ship's firemain from a riser on the fueling dolphin, but there was insufficient pressure to operate a PERI-jet to dewater MER 2.

Ship's force also attempted to rig two P-100 pumps in tandem in order to control MER 2 flooding but lacked a three inch to two-and-a half inch reducing coupler needed to mate suction and discharge lines between the two pumps. (The coupler was not part of the ship's damage control equipment.) An attempt was then made to rig a PERI-jet in tandem with a P-100 in MER 2 but the arrangement was unable to overcome the static discharge head between the water level and the damage control deck overboard discharge fittings. The single P-100/PERI-jet arrangement was finally successful when ship's force cut a lower overboard discharge hole through the ship's hull in MER 2's upper level using the Portable Exothermic Cutting Unit. Flooding in MER 2 was finally brought under control when two air-driven pumps provided by HAWES and supplied with LP air from the pier were added to the effort. MER 2 dewatering were completed about 1600.

At 0005 on 16 October, COLE engineers were finally successful in re-starting NR 3 SSGTG. Within an hour, electrical power, firemain, CHT, seawater service and air systems were restored. Air conditioning was restored to its previous level of service by 0200.

Additional information on engineering and damage control systems is provided in enclosure (6).

(4) **Phase Four** (160005C Oct 00 - 171942C Oct 00): With services restored to levels attained prior to the loss of NR 3 SSGTG and having benefit of help from MDSU TWO, U.S. Marine Corps FAST team, USS HAWES (FFG 53), USS DONALD COOK (DDG 75), U.S. Central Command, and technical and law enforcement communities, COLE's subsequent efforts turned toward recovery of remains, continued restoration of equipment, and preparing the ship for onward movement.

5. Damage control training program. COLE completed the Basic Phase of Inter-Deployment Training Cycle (IDTC) in December 1999, with Final Evaluation Period being conducted in November 1999. She continued to conduct formal damage control training using fleet schools, both individual and team, and

through Limited Team Training visits from ATG Norfolk until her deployment.

A self-assessment of damage control training conducted in August 2000 indicated improvement was needed in Chemical, Biological and Radiological Defense (CBRD) and Main Space fire fighting. In view of that assessment, continuing personnel turnover since completion of IDTC Basic Phase, and in anticipation of Arabian Gulf operations, the Command placed a high priority on basic hands-on damage control training during its Atlantic and Mediterranean transit.

The ship's weekly training regimen featured a damage control day that included repair locker training emphasizing individual and team hands-on skills development in the morning followed by Damage Control Training Team (DCTT) or Integrated Training Team (ITT) scenario in the afternoon. Following the Atlantic crossing, individual repair locker training stressing individual hands-on skills, damage control organization training led by DCTT, and ship-wide ITT-led training was held frequently. COLE routinely conducted damage control training that included loss of communications. It was ship's practice to impose communications losses during each DCTT/ITT scenario.

The inquiry determined from EPMAC and NPC data that 48% of officers, 35.8% Chief Petty Officers, and 38.6% of E-1/6 had turned over between the end of the basic phase and 12 October 2000. Anecdotal information was provided that approximately 20 new Sailors reported onboard COLE within two weeks of deployment.

COLE was reporting herself C-1 in the Training Resource area of SORTS on 12 October.

Additional information on COLE's damage control training is provided in enclosure (7).

6. Personnel qualifications. Interviews indicate that personnel qualifications in damage control was approximately 85% - 89% complete. Documentation was not available to confirm this figure.

7. Effectiveness of damage control equipment.

a. FIREMAIN. At the time of the explosion, material condition YOKE was set on the firemain. NR 5 firepump continued

to run after the explosion. NR 2 firepump shutdown from loss of power. The explosion destroyed port side firemain piping between approximately frames 174 and 220. The crew initially tried to isolate the damaged section by closing ZEBRA valves and through closing valves FM-V-330 and FM-V-326. The Data Multiplexing System (DMS) was cycling firemain valves making it difficult to control firemain pressure and configuration. This problem of uncommanded cycling of firemain valves had previously been noted in the DDG 51 class but had reportedly been corrected. Many butterfly style firemain isolation valves leaked by preventing isolation of some firemain sections.

Within the first hour after the explosion, the crew was able to restore starboard side firemain from frame 408 forward to frame 220. The crew reported no significant damage to firemain piping except in the vicinity of MER 1, but some minor repair (soft patches) was required.

Firemain forward of frame 220 was restored later in two steps. The first step restored firemain to frame 174 by the end of the day on 13 October. Firemain through the forward end of the loop and around the port side to approximately frame 90 was restored by 17 October in order to provide firemain pressure to forward VLS and the five-inch magazine sprinklers prior to moving the ship to the MV BLUE MARLIN. The remainder of the firemain was not restored.

b. MAIN DRAIN SYSTEM.

AMR 1: The main drain system was undamaged in AMR 1 and was isolated from the damaged portion of the system in MER 1 by closing bulkhead isolation valve MD-V-45. Once firemain was restored to AMR 1 on 13 October, the installed main space eductor in AMR 1 was used to dewater AMR 1, firemain pressure permitting.

MER 1: MER 1 had free communication with the sea and the main drain system in the space appeared to have been destroyed by the explosion. No action was taken to assess the main drain system in that space.

AMR 2: AMR 2 was made inaccessible by the initial damage, preventing operation of the installed main drain eductor in the space (none of the main drain system valves in the space had

remote operators with the exception of MD-V-12). The extent of damage to the system in AMR 2 could not be determined.

MER 2: The main drain system was undamaged in MER 2. The main drain eductor was used extensively to dewater that space; however, the MER 2 main drain eductor could not be used to dewater AMR2 (as designed) because the electrically operated bilge suction valve MD-V-12 could not be remotely operated. The inability to close the system isolation valve on the aft bulkhead of MER 1 (MD-V-46) would have also prevented suction being taken in AMR 2.

c. AFFF. The AFFF system main deck piping was undamaged by the explosion. The forward proportioner was unusable due to lack of power. The aft proportioner was initially caution tagged to prevent inadvertent cycling of the solenoid operated pilot valves (SOPV).

Five-gallon AFFF refill cans were emptied into spaces by hand to blanket the fuel spilled internal to the ship. In MER 1, AFFF was poured down the natural ventilation trunk and was replenished as required based on the space having free communication with the sea.

AFFF was used freely and the ship's own supply was nearly expended (with the exception of the foam in the forward proportioner tank) by the end of the day on 13 October. Replacement AFFF was flown in from FIFTH Fleet and was obtained from USS DONALD COOK and USS HAWES.

d. Casualty Power. The crew reported that the actual configuration of the casualty power system did not match the damage control plates and that there were an insufficient number of bulkhead pass-throughs. Each run was initially made by hooking cables to each other vice using the installed bulkhead pass-throughs. Later the cables were re-rigged through the bulkhead pass-throughs to improve watertight integrity. Some of the runs were in excess of 250 feet.

Shortly before the ship was moved to MV BLUE MARLIN, one of the casualty power runs shorted at the load end starting a Class "C" fire in the casualty power breaker on NR 3 Switchboard.

e. HALON. The HALON system was not used.

f. P-100 Dewatering pumps. P-100 dewatering pumps were used in conjunction with PERI-jet and S-type eductors to dewater AMR 1 and AMR 2. The water level in AMR 2 was initially reduced to 27 inches using three PERI-jet Eductors. At 0100 on 15 October, members of the crew heard a noise and discovered that the flooding in AMR 2 had increased significantly. A total of three PERI-jet and three S-type eductors were used to combat the flooding.

Problems with the P-100 identified by the crew were:

(1) The P-100 did not have sufficient discharge pressure to raise water to the level of the installed overboard discharges. After trying many configurations of pumps and eductors, the PECU was used to cut a hole in the hull in MER 2 to reduce the static head required to discharge water overboard. By using a PERI-jet eductor drawing suction from the bilge with its seawater supply drawing suction through the hole in the hull, fairly efficient dewatering was established.

(2) P-100s could not be rigged in tandem. The 3 inch to 2 1/2 inch double female adapter required for that configuration is not part of ship's equipment.

(3) The discharge valve on one of the pumps seized, but was repaired within minutes.

(4) The exhaust hose for the P-100 is very short. Ship's force used the LM2500 exhaust ducting for the exhaust path.

g. Eductors. The crew experienced 100% reliability in the use of both PERI-jet and S-type eductors.

h. Portable Hydraulic Access and Rescue System (PHARS). The crew stated that PHARS was invaluable, had 100% reliability, and performed extremely well in all applications.

i. Portable Exothermic Cutting Unit (PECU). PECU worked well when used to cut a hole in the hull in MER 2. Its use was minimized due to the extensive fuel oil fumes permeating the ship.

j. Shoring. Shoring was used to support the after bulkhead of AMR 1 and the forward bulkhead of MER 2. The crew reported no

difficulty in using the equipment. The ship's entire stock of shoring materials was consumed in the recovery.

k. Interior Communications.

(1) Interior Voice Communication System (IVCS) was disabled by the explosion.

(2) General Announcing System (1MC) was disabled by the explosion but was restored at 1041 on 13 October.

(3) Wireless Communication (WIFCOM) was the only communication path between CCS and Repair 3.

(4) The 25MC in CCS was used to communicate with Combat Systems Maintenance Central.

(5) X5J circuits (salt and pepper lines) were rigged along the damage control deck to supplement the Wireless Internal Communication System (WICS).

(6) WICS proved to be 100% reliable and played a critical role in command and control efforts. The coordination of stabilizing wounded personnel into localized triage areas throughout the ship would have been much more difficult without WICS.

l. Portable Desmoking equipment. The smoke from the explosion dissipated quickly without the need for portable desmoking equipment. In the days following the explosion, box fans and Ram Fans 2000 were used to provide ventilation in areas where installed ventilation systems were damaged or without power.

m. Self-Contained Breathing Apparatus (SCBA). With the exception of the approximately 20 SCBAs amidships destroyed in the explosion, SCBAs operated flawlessly.

n. Emergency Escape Breathing Device (EEBD). The ship was equipped with SCOTT EEBD's which performed flawlessly. The only comment on the SCOTT EEBD's was that the pull ring needs to be larger.

Additional information on damage control equipment is provided in enclosure (6).

8. Lessons learned.

a. Flashlights saved lives, both as emergency signaling devices and in the absence of emergency lighting. Consideration should be given to issuing flashlights to all crewmembers.

b. The size of the pockets in the standard Navy coveralls was inadequate for carrying the large amount of equipment necessary during the damage control effort in COLE (radios, flashlights, writing materials, tools). The addition of a utility belt to hook the equipment on would have resolved this problem.

c. WICS was the only internal communication system that survived intact and provided total area coverage. IVCS and the 1MC were disabled at the time of the explosion and were supplanted by WICS. Additionally, the DC WIFCOM antenna was damaged in the initial explosion and its coverage, except for Repair Locker NR 3, had to be supplemented by WICS. Because the ship is equipped with IVCS, sound powered phone coverage is very limited. Recommend that WICS and sound powered phone coverage be expanded for redundancy.

d. While attempting to rig casualty power, the casualty power configuration on the damage control plates did not match the physical configuration of the ship. The ship reported that none of the electricians onboard had ever actually rigged and energized casualty power. The validation of the ship's casualty power configuration and hands on training of the rigging of the casualty power system should be conducted during the IDTC.

e. Many butterfly firemain isolation valves initially leaked by preventing isolation of major sections of the firemain. This problem prevented normal operation of the main drainage system, caused low firemain pressure, and prevented the use of installed AFFF systems. A more effective firemain isolation valve is needed.

f. The DDG-51 class does not have mechanical or hydraulic remote operators on the damage control deck for all key isolation valves. Additionally, the lack of system isolation valves on both sides of a bulkhead prevented damaged sections of the HP Air System, the LP Air System, the Main Drain System, and the Fuel Oil Transfer System from being isolated until divers

arrived and could access the damaged spaces (the electrical remote operators either did not have power or failed). Addition of bulkhead isolation valves and a redesign of remote operators are appropriate.

g. Watchstanders had to develop a procedure (using the system diagram) for aligning JP-5 (emergency fuel source) to the fuel gravity feed tanks for NR 3 SSGTG. The Engineering Operating Procedure CP.TSFA does not include steps to align JP-5 to NR 3 GTG gravity head tank. Recommend a specific EOP be added to align JP-5 to the generator.

h. Power loss to the Tank Level Indicators (TLI) for the SSGTG fuel gravity feed tanks prohibits positive monitoring of the fuel level in these tanks. A sight glass should be installed on the side of the fuel gravity feed tanks as in DDs and CGs.

i. None of the three medical stretcher/litter types aboard (Stokes, SAR, Miller Board) would pass through the CPS air locks without having both doors open (the doors were not spaced far enough apart).

j. The ship's LAN servers were located low in the ship and were destroyed in the initial flooding. Consideration should be given to installing at least one of the ship's servers above the water line.

k. The ship's food supply was damaged and/or made inaccessible by the explosion and subsequent flooding. Consider storing emergency food rations (MREs) onboard.

l. SSGTG blow in doors require LP air to close. Since the ships LP air system was damaged, the NR 3 GTG blow in doors could not be closed until air was restored. An alternate method of being able to secure the blow in doors in casualty situations should be developed.

m. Following the explosion, the Data Multiplexing System became unreliable causing uncommanded cycling of firemain valves and loss of much of the remote monitoring capability of the Machinery Control System. The hardwired portion of the Machinery Control System appeared to operate without fault. A method of disabling the DMS should be installed in CCS.

n. The crew reported that SCBAs performed well; however, it was noted that the voice amplifier boxes were disabled by being water soaked.

o. Recent conduct of shipwide EGRESS/EEBD/SCBA training in COLE was reported by the crew as a major reason that many lives were saved.

p. The validation of the ship's electrical isolation lists during IDTC allowed rapid and accurate isolation of the electrical damage caused by the explosion and the secondary effects. The use of these electrical isolation lists eliminated class "C" fires and assisted in the restoration of equipment

q. The two 50 gallon potable emergency water supplies at the Battle Dressing Stations were quickly expended. The emergency and bottled water supplies held onboard were quickly expended and the ship's reverse osmosis (RO) units were destroyed in the explosion. Consideration should be given to providing a small portable RO unit for such emergencies.

r. The Portable Hydraulic Access and Rescue System (PHARS) "Jaws of Life" was used extensively for extracting personnel from wreckage confirming the value of providing this system and training personnel in its use.

s. The explosion destroyed/disabled all external communications antennas. The only long range off ship communications was provided by the defense attaché's unsecure cellular telephone. Either portable antennas that could be used with installed ship's communication equipment or a portable secure satellite transceiver should be added to the ship's equipage.

t. The performance of the crew in providing first aid for the injured validated the first aid training conducted. Medical personnel stated that the classic "GTMO Eight" wounds were particularly relevant to the types of casualties that they treated. Additionally, having consistently assigned and trained stretcher-bearers was noted by the crew as greatly facilitating the efficient and safe movement of casualties.

u. Patient transport resources were greatly taxed with Stokes and SAR litters being the primary means of transportation. The ship had 11 Stokes litters aboard (old ones

had not been removed). All were used along with the two SAR litters. The medical team condemned Miller boards as being difficult to transport patients aboard ship and providing inadequate stability for even moderate weight patients.

v. Shipwide distribution of medical supplies in First Aid Boxes and Portable Medical Lockers (PMLs) greatly improved their survivability and ready accessibility to the crew.

w. P-100 portable dewatering pumps were inadequate for both dewatering and firefighting. It had difficulty taking suction and the length of discharge hose that was required to reach the damage control deck put too much static head on the pump. Additionally, when the crew attempted to place two P-100's in series to improve their output, the necessary fittings were not available. The exhaust hoses leaked and when sufficient exhaust hose was rigged to reach the damage control deck, there was too much back pressure for the engines to run efficiently.

9. Findings of fact and opinions are provided in enclosure (8).

V/R J. L. McClane

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